TRANSLATION

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(54) Title:
RUPTURE CONVERSION MACHINE

(57) Abstract:

A rupture conversion machine for rupture conversion of chemical fiber cables 1 into chemical fiber strips 16 has, for its pre-rupturing head and rupturing head in each case two driven transport cylinders 12',12" to which a hydraulically loaded, freely rotatable pressure roller 13 is assigned, between which the chemical fiber cable 1 that is to be processed is conveyed in a force-locking manner. To reduce slippage in the pre-rupture head and the rupture head it is suggested that the circumferential speed of the second transport cylinder 12" in the process direction is larger than that of the first transport cylinder 12' and/or that the circumferential speed of the pressure roller 13 in the clamping range K" between this and the second transport cylinder 12" in the process direction is larger than in the clamping range K' between the pressure roller 13 and the first transport cylinder 12'.

Specification

The invention pertains to a rupture conversion machine for rupture conversion of chemical fiber cables into chemical fiber strips with in each case one preferably hydraulically loaded, freely rotatable pressure roller and two pre-rupture heads/rupture heads adjacent to this and having driven transport cylinders, wherein the chemical fiber cables to be processed are conveyed in a force-locking manner between the transport cylinders and the assigned pressure rollers.

Rupture conversion machines are used in order to convert chemical fiber cables made of endless filaments in a single working step into spinnable chemical fiber belts made of fibers of finite length. This working process involves several process steps, in which the chemical fiber cables are first elongated and subsequently ruptured by further elongation. Primarily PAC chemical fiber cables are processed in this way. In addition, chemical fiber cables made of PES, viscose, or Kevlar are also processed.

Rupture conversion machines of this type have several pre-rupture heads and rupture heads in succession. Each of these consists of a hydraulically loaded, freely rotatable pressure roller, to which two transport cylinders are assigned, each of which is driven, located adjacent to the pressure roller. The chemical fiber cables to be processed are conveyed in force-locking fashion between the transport cylinders and the assigned pressure rollers.

On the basis of the transport speed increasing stepwise from one pre-rupture head to the next and from one rupture head to the next, the chemical fiber cable is increasingly elongated. When the breaking elongation for the individual filaments of the chemical fiber cable is exceeded, the respective filament ruptures. Because of the breaking elongation that varies from filament to filament and because of the largely random break localization within the zones between two pre-rupture heads or rupture heads, the ruptured filaments are held in place by the remainder of the chemical fiber cable without pulling away occurring.

The chemical fiber cables are placed in the rupture conversion machine in a crimped condition, wherein the crimping ensures the cable cohesion. For the rupture conversion process, however, the crimping must be eliminated, wherein for this purpose in the past, in addition to an intake frame and an intake head an additional pre-rupture head was used, so that to the first actual pre-rupture head of the rupture conversion machine, by means of a strain zone connected in advance (strain for example 5%) a chemical fiber cable with the crimping removed is supplied. This preliminary pre-rupture head for decrimping, however, was eliminated for the sake of efficiency.

However, practice shows that elimination of the preconnected decrimping zone leads to increased slippage of the chemical fiber cable between the second transport cylinder in the process direction and the assigned pressure roller for the first actual pre-rupture head. Furthermore, it was found that slippage also exists on the surface of the pressure roller. This slippage formation has the following reasons. The transport cylinders of the pre-rupture heads or rupture heads are driven at the same rotation speed. The entering chemical fiber cable is under a relatively low tensile stress, whereas on the other hand the emerging chemical fiber cable, because of the more rapidly running next pre-rupture head or rupture head, is under elevated tensile stress. Furthermore, the circumferential speed of the pressure rollers, when these have an elastic surface, do not correspond exactly to the surface speeds of the assigned transport cylinders. Through diameter reduction of the pressure roller coatings, the circumferential speed of the pressure roller is specifically lower than the surface speed of the transport cylinder. Likewise the speed of the chemical fiber cable from entry into the pre-rupture head or rupture head to its exit can change, wherein as a rule the chemical fiber cable speed increases and thus exceeds the surface speed of the second transport cylinder in the process direction in the clamping region with the pressure roller. The speed difference corresponds to the reduction in crimping in the chemical fiber cable between the entry and the emergence.

The slippage disadvantageously results in abrasion of finishing and possibly oligomer particles in the case of certain chemical fiber cable grades, so that increased dust deposition can be seen on the rupture conversion machine. For this reason, cleaning elements must be provided for removing the dust deposit, since the formation of dust must be avoided for certain cable grades. If slippage exists on the surface of the pressure roller, in the case of certain cable materials this disadvantageously leads to dust deposits on the pressure roller surface.

Thus altogether slippage exists because of the cable crimping removal and because of the differences in cable tension at inlet and outlet and finally because of the diameter reduction of the pressure roller coating in the clamping regions with the transport cylinder.

Starting from this, the invention is based on the goal of further developing the rupture conversion machine of the initially mentioned type in such a way that no slippage develops between the transport cylinders and the assigned pressure roller.

As a technical solution it is suggested with the invention that the circumferential speed of the second transport cylinder in the process direction is greater than that of the first transport cylinder and/or that the circumferential speed of the pressure roller in the clamping region between the transport cylinders is greater than in the clamping region between the pressure roller and the first transport cylinder.

The concept of the invention thus consists of eliminating or at least reducing to a tolerable degree the slippage caused by different surface speeds in the case of a pre-rupture head and a rupture head in that the cable decrimping that takes place within the head and tensile stress differences that are compensated by cable elongation are balanced out by increasing the transport speed. As a result of the slippage elimination in accordance with the invention a substantial decrease is achieved in the dust formation during the rupture conversion process. Since the dust removed cannot always be completely vacuumed away, this results in a corresponding reduction in the dust emission in the operating area of the machine. This meshes with efforts for improved health protection for the operating personnel. In addition, the dust emission is reduced in the processing steps that follow the rupture conversion process, especially the drawing passes, so that there as well the possibility of a health risk for the operating personnel is opposed.

Preferably the difference in circumferential speed amounts to 1 to 11%. In the case of conventional chemical fibers this is sufficient to avoid slippage in the pre-rupture heads or rupture heads.

In a first alternative for the design to realize different circumferential speeds of the transport cylinders it is suggested that the external diameter of the second transport cylinder is larger than the external diameter of the first transport cylinder, wherein the two transport cylinders preferably run with the same rotation speed. In a second alternative it is suggested that the rotation speed of the second transport cylinder is larger than the rotation speed of the first transport cylinder, wherein these preferably have the same external diameter. Nevertheless it is also conceivable that the two alternatives may be combined so that both different external diameters and different rotation speeds will be provided. In the second alternative the two transport cylinders have either a common drive with different gear gradations for the two transport cylinders, or each has its own drive with individual control or regulation.

In an advantageous further development of the transport cylinders, their surfaces are in each case provided with a ceramic coating, wherein the roughness of this ceramic coating is preferably between 10 and 50 µm.

In a further development of the rupture conversion machine in accordance with the invention it is suggested that the surface of the pressure roller has a coating made from an elastic material and that the pressure roller be more heavily loaded in the direction of the first transport cylinder than in the direction of the second transport cylinder, and thus the elastic coating in the clamping region between the pressure roller and this first transport cylinder with a corresponding pressure roller diameter reduction is pressed in more strongly than in the clamping region between the pressure roller and the second transport cylinder. The difference in the surface speed

is thus achieved by a one-sided reduction of the effective pressure roller diameter in the contact region with the first transport cylinder, so that slippage on the surface of the pressure roller is eliminated in a technically simple way.

Preferably in this process the loading direction of the pressure roller is at an angle of between 5E and 75E with reference to the perpendicular to the connecting line of the axes of the transport cylinders.

Vulkollan or rubber is preferably used for the elastic material of the pressure roller coating.

Finally, the hardness of the elastic material for coating the pressure roller is preferably between 40 and 100 Shore A.

A rupture conversion machine with three different embodiments of the pre-rupture head or rupture head in accordance with the invention will be described in the following on the basis of the schematic drawings. In these drawings:

Figure 1 shows a schematic view of a rupture conversion machine;

Figure 2 shows a schematic representation of a first embodiment of a rupture head;

Figure 3 shows a schematic representation of a second embodiment of a rupture head;

Figure 4 shows a schematic representation of a third embodiment of a rupture head.

In Figure 1, a rupture conversion machine is shown. To this, a chemical fiber cable 1 that is to undergo rupture conversion is introduced, which consists for example of 300,000 filaments of 3.3 dtex each (g/10,000 m) and as a flat belt of about 30 cm width is rolled up in a ball 2 of 700 kp weight by the chemical fiber manufacturer. This ball 2 is placed in front of the rupture conversion machine, wherein a total of two balls 2 are recognizable in the exemplified embodiment presented.

The rupture conversion machine first has a pull-in frame 3, in which the chemical fiber cable 1 is centered over adjustable straight and curved guide rods 4 and adjusted in width. At the same time the crimping imparted to the chemical fiber cable 1 by the chemical fiber manufacturer is eliminated. In an intake head 5 following this, the chemical fiber cable 1 is further aligned by means of adjustable guide rods, adjusted in width, and decrimped.

Following the intake head 5 the actual processing zones are arranged in the form of pre-rupture heads 6, 7, 8 and rupture heads 9, 10, 11. In these processing zones between the pre-rupture heads 6, 7, 8 and the rupture heads 9, 10, 11, the chemical fiber cable 1 is elongated and ruptured stepwise. The pre-rupture heads 6, 7, 8 and the rupture heads 9, 10, 11 each consist of driven and ceramic-coated transport cylinders 12 as well as hydraulically loaded and Vulkollane-coated pressure rollers 13 assigned to them. The particular design of these transport cylinders 12

and the pressure rollers 13 will be described in greater detail in the following on the basis of Figures 2 to 4. By means of a main drive motor, the gears of the transport cylinder 12 are driven over a king shaft. Over alternating gears, the circumferential speed of the transport cylinder 12 is set higher step by step.

Between the first pre-rupture head 6 and the second pre-rupture head 7, a heating zone 14 is provided, in which by contact heating plates 15 a distortion process in the heated state of the chemical fiber cable 1 is carried out to impart to the material a residual shrinkage that can be loosened by the action of steam.

After leaving the last rupture head 11, the rupture converted chemical fiber strip 16 passes through a condenser 17 over delivery rollers 18 into a crimping chamber 19. For producing the so-called high-bush yarns (HB yarn) about 50% of the production is treated in a steam tunnel 20 with saturated steam to release the shrinkage. The remaining 50% are placed, from the crimping chamber 19, directly on a cooling conveyor belt 21. The two components are later mixed, and the residual shrinkage of the one component is released in the yarn state by saturated steam treatment. In this process the fibers that have already had their shrinkage released through shrinkage of the fibers that are already released in the yarn state (shortening by about 20%) and then form the so-called high bush yarn. Over the cooling conveyor belt 21 finally the rupture converted chemical fiber strip 16 is placed in a rotating can 22, wherein the can content is increased under the influence of a compression roller 23.

Various embodiments of the special design of the pre-rupture head 6, 7, 8 or the rupture head 9, 10, 11 in accordance with the invention will be described in the following on the basis of Figures 2 to 4.

In the embodiment in Figure 2 the chemical fiber cable 1 is conveyed in a so-called omega loop around the two transport cylinders 12', 12" and around the pressure roller 13, wherein the crimping is indicated in the chemical fiber cable 1. The two transport cylinders 12', 12" rotate at the same speed. However, the rear (second) transport cylinder 12" in the process direction has a larger external diameter than the front (first) transport cylinder 12'. The two transport cylinders 12', 12" have assigned to them the hydraulically loaded, freely rotatable pressure cylinder 13, which is provided with an elastic coating 24 of Vulkollan or rubber. The pressure cylinder 13 in this process is pressed against the transport cylinder 12', 12" in such a way that the elastic coating 24 is pressed in, so that in this region the clamping region K', K" for the chemical fiber cable 1 is defined between the respective transport cylinder 12', 12" and the pressure roller 13. As a result of the small diameter enlargement of the second transport cylinder 12" compared to the first transport cylinder 12' of for example 3%, a slight speed increase in the

process direction is brought about, so that the chemical fiber cable 1 is conveyed with a higher speed in the clamping region K" than in the clamping region K'. With a suitable selection of the external diameters of the two transport cylinders 12', 12" the chemical fiber cable 1 slides only slightly over the surfaces of these transport cylinders 12', 12", so that slippage is largely avoided.

The embodiment in Figure 3 in its basic concept essentially corresponds to the embodiment shown in Figure 2. In addition, however, this embodiment between the two transport cylinders 12', 12" has an additional transport cylinder 25, around which the chemical fiber cable 1 is wound instead of around the pressure roller 13. Finally a fourth transport cylinder 26 is assigned to the second transport cylinder 12".

In this embodiment the chemical fiber cable 1 is conveyed at the outlet with, for example, a 5% higher speed than at the inlet. For this purpose the four transport cylinders, 12', 12", 25, 26 have different diameters. For example, these diameters of the transport cylinders 12', 25, 12", 26 successively have diameters of 150 mm, 153 mm, 156 mm, and 157.5 mm. Through the stepwise increase in the circumferential speed, corresponding to the cable decrimping or cable expansion, of the transport cylinders 12', 12", 25, 26 driven at a constant rotation speed, slippage at the second transport roller surface is largely avoided.

Instead of a diameter enlargement, the increase in the circumferential speeds can also be achieved by an increase in the rotation speed if the transport cylinder diameters are constant. This can be accomplished through a corresponding gear ratio. It is also possible to provide individually controlled or regulated single drives.

The measures explained on the basis of Figures 2 and 3 are intended to reduce slippage on the transport roller surfaces. Furthermore, slippage is also to be observed on the surface of the pressure roller 13, which in the case of certain cable materials leads to dust deposits on the pressure roller surface.

To avoid slippage in the clamping region K" between the pressure roller 13 which has its elastic coating 24 and the second transport cylinder 12", an additional measure is suggested in conjunction with the third embodiment on the basis of Figure 4. Corresponding to the embodiment in Figure 2, here also the crimped chemical fiber cable 1 runs in an omega shape around the first transport cylinder 12', the pressure roller 13, and the second transport cylinder 12" and leaves the distortion head shown as a reduced-crimp chemical fiber cable 1. The second transport cylinder 12" has, corresponding to its larger diameter, for example a 3% higher circumferential speed than the first transport cylinder 12'. Since the chemical fiber cable 1 on the way from the clamping region K' to the clamping region K" undergoes a crimping reduction of for example 3% and thus becomes longer, no slippage takes place between the chemical fiber

cable 1 and the surface of the second transport cylinder 12". If the pressure roller 13 in the direction R of the perpendicular S to the connecting line V of the axes A of the two transport cylinders 12', 12" were loaded, the diameter of the pressure roller 13 in the clamping regions K', K" would be of about the same size and correspondingly the circumferential speed. Since the chemical fiber cable 1, because of the higher tensile force at the outlet, is transported with a higher speed in the clamping region K" than in the clamping region K', the chemical fiber cable 1 in the clamping region K" would slip on the surface of the pressure roller 13. To avoid this, the pressure roller 13 is loaded in the direction R directed toward the first transport cylinder 12'. This not only results in a lower clamping effect in the clamping region K", but also, as a result of the compression of the elastic coating 24 in the clamping region K', the effective diameter and correspondingly the surface speed of the pressure roller 13 in this clamping region K' is reduced by for example 3% in comparison to the clamping region K". As a result of this oblique loading direction R of the pressure roller 13, therefore the slippage on the pressure roller 13 is reduced.

List of Symbols

1	chemical fiber cable
2	ball
3	intake frame
4	guide rod
5	intake head
6	pre-rupture head
7	pre-rupture head
8	pre-rupture head
9	rupture head
10	rupture head
11	rupture head
12	transport cylinder
12'	transport cylinder
12"	transport cylinder
13	pressure roller
14	heating zone
15	contact heating plate
16	chemical fiber belt
17	condenser

18	delivery roller
19	crimping chamber
20	steam tunnel
21	cooling transport belt
22	can
23	compression roller
24	elastic coating
25	transport cylinder
26	transport cylinder
A	axis
K'	clamping region
K"	clamping region
R	loading direction
S	perpendicular
V	connecting line

Claims

1. Rupture conversion machine for rupture conversion of chemical fiber cables (1) to chemical fiber belts (16) with pre-rupture heads (6, 7, 8) and rupture heads (9, 10, 11) each having a preferably hydraulically loaded, freely rotatable pressure roller (13) and two adjacent, driven transport cylinders (12',12"), wherein the chemical fiber cables (1) are conveyed in a force-locking manner between the transport cylinders (12', 12") and the assigned pressure rollers (13), **characterized in that** the circumferential speed of the second transport cylinder (12") in the process direction is greater than that of the first transport cylinder (12') and/or that the circumferential speed of the pressure roller (13) in the clamping region (K") between this and the second transport cylinder (12") in the process direction is greater than in the clamping region (K') between the pressure roller (13) and the first transport cylinder (12').

2. Rupture conversion machine in accordance with Claim 1, characterized in that the difference in the circumferential speed amounts to 1 to 11%.

3. Rupture conversion machine in accordance with Claim 1 or 2, characterized in that the external diameter of the second transport cylinder (12") is larger than the external diameter of the first transport cylinder (12').

4. Rupture conversion machine in accordance with one of the Claims 1 to 3, characterized in that the rotation speed of the second transport cylinder (12") is larger than the rotation speed of the first transport cylinder (12').

5. Rupture conversion machine in accordance with Claim 4, characterized in that the two transport cylinders (12', 12") have a common drive with different gear ratios for the two transport cylinders (12', 12").

6. Rupture conversion machine in accordance with Claim 4, characterized in that the two transport cylinders (12', 12") each have their own drive with an individual control or regulation.

7. Rupture conversion machine in accordance with one of the Claims 1 to 6, characterized in that the surfaces of the two transport cylinders (12', 12") are each provided with a ceramic coating.

8. Rupture conversion machine in accordance with Claim 7, characterized in that the roughness of the ceramic coating is between 10 and 50 μm.

9. Rupture conversion machine in accordance with one of the Claims 1 to 8, characterized in that the surface of the pressure roller (13) has a coating (24) of elastic material and that the pressure roller (13) is more strongly loaded in the direction of the first transport cylinder (12') than in the direction of the second transport cylinder (12") and thus the elastic coating (24) in the clamping region (K') between the pressure roller (13) and the first transport cylinder (12) with a corresponding pressure roller diameter reduction is more strongly pressed in than in the clamping region (K") between the pressure roller (13) and the second transport cylinder (12").

10. Rupture conversion machine in accordance with Claim 9, characterized in that the loading direction (R) of the pressure roller (13) with respect to the perpendicular (S) to the connecting line (V) of the axes (A) of the transport cylinders (12', 12") is inclined at an angle between 5E and 75E.

11. Rupture conversion machine in accordance with Claim 9 or 10, characterized in that the elastic material for the coating (24) of the pressure roller (13) is Vulkollan or rubber.

12. Rupture conversion machine according to one of the Claims 9 to 11, characterized in that the hardness of the elastic material for the coating (24) of the pressure roller (13) is between 40 and 110 Shore A.

<u>4 pages of drawings attached</u>

Fig. 1

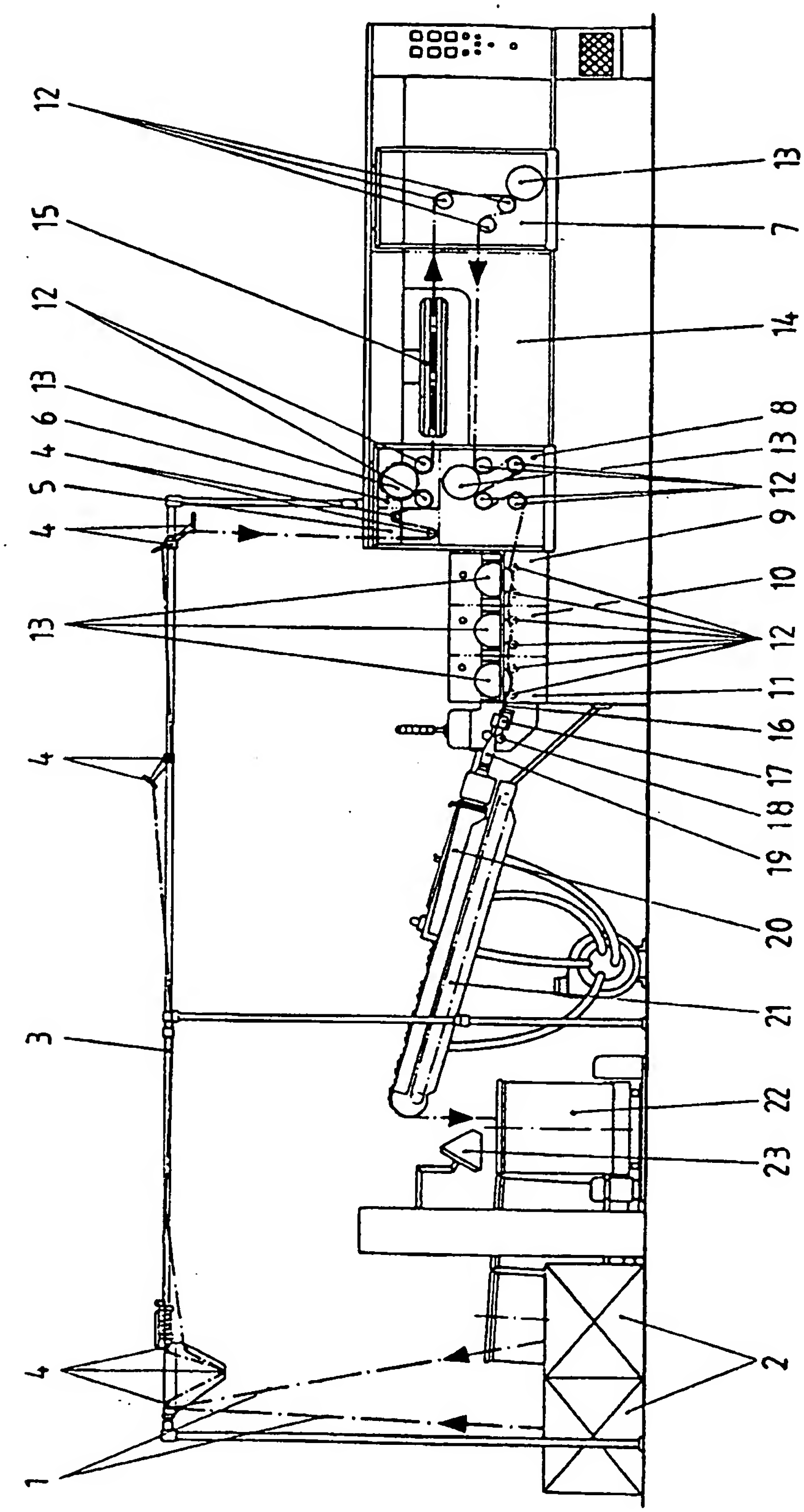


Fig. 2

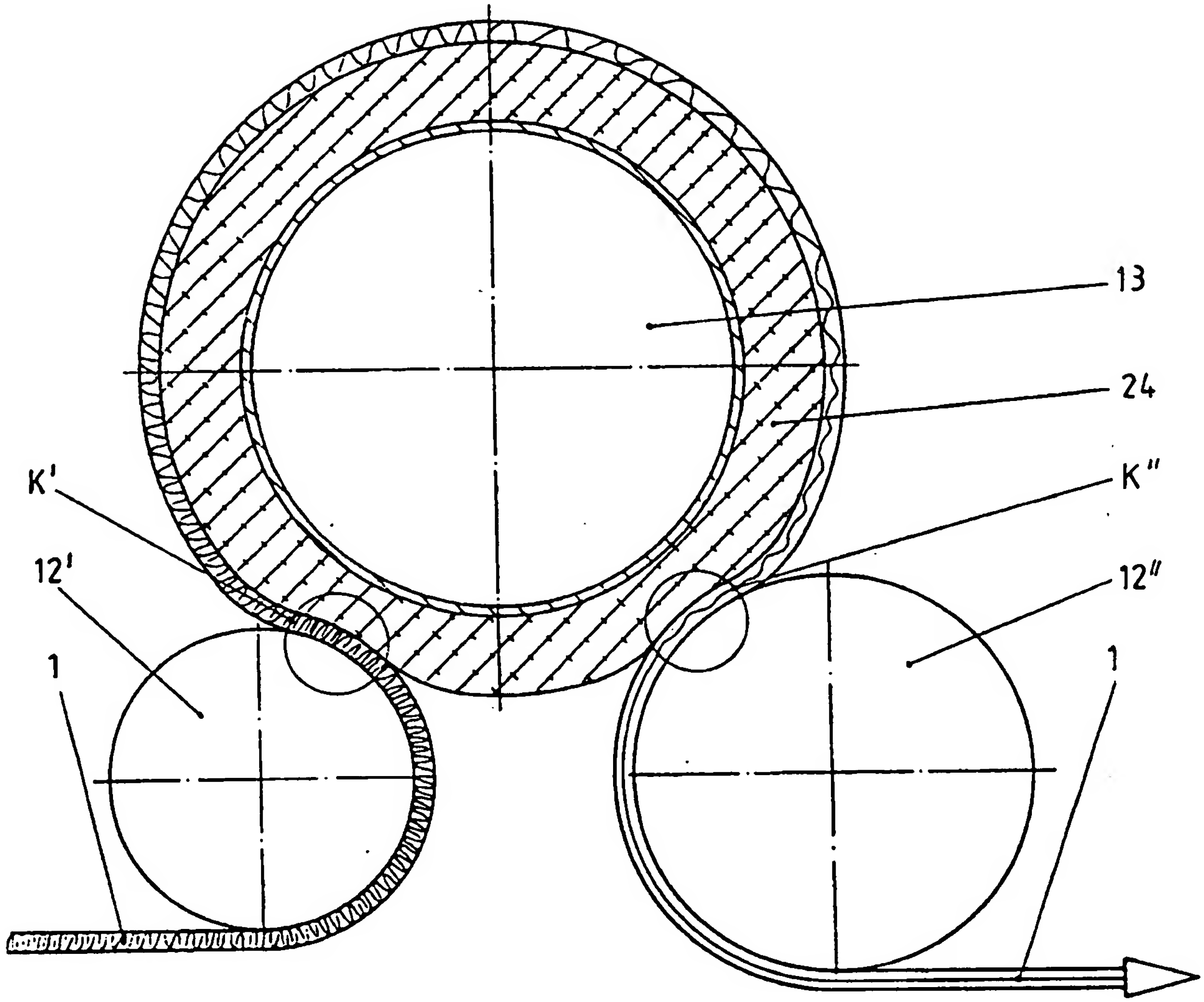


Fig.3

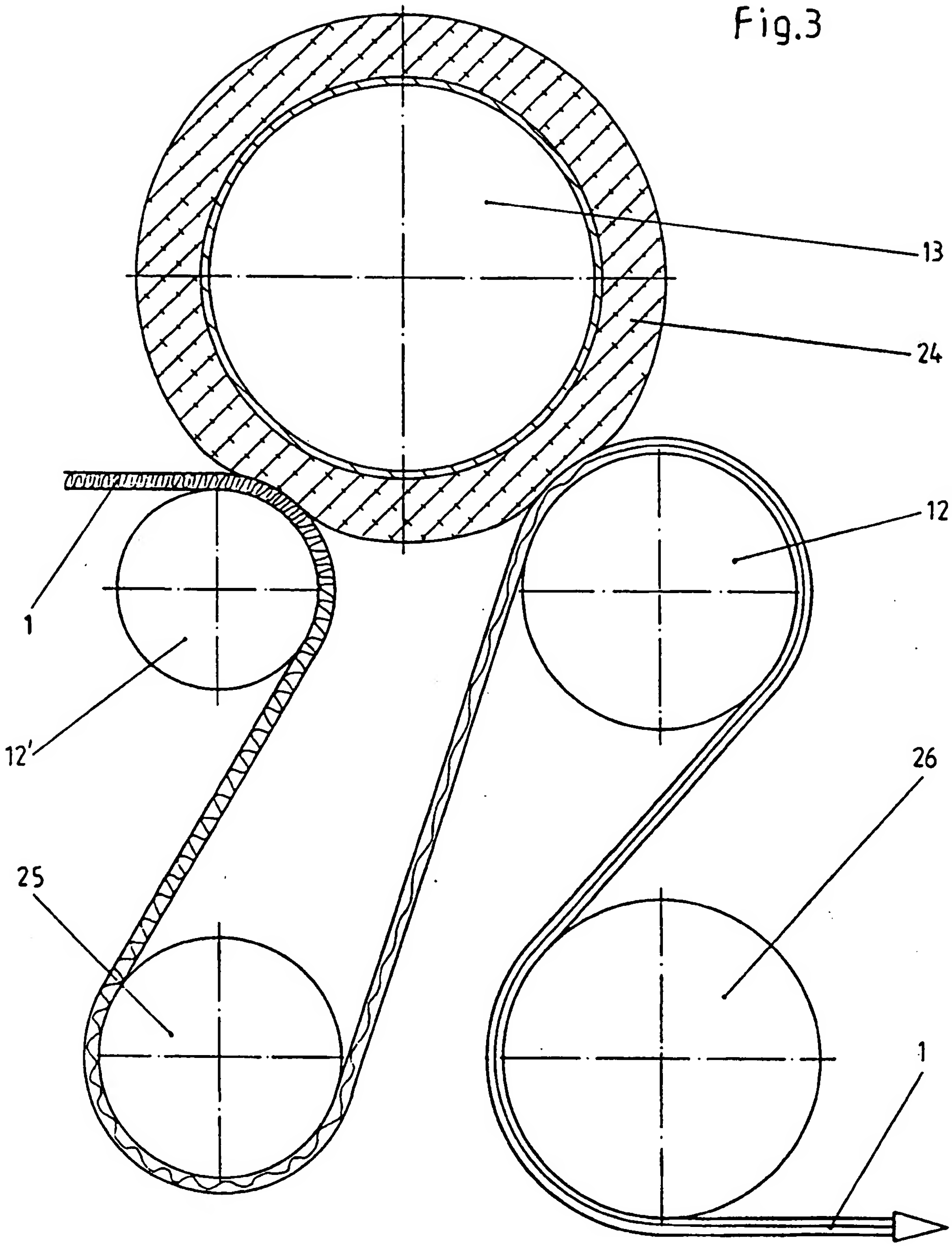
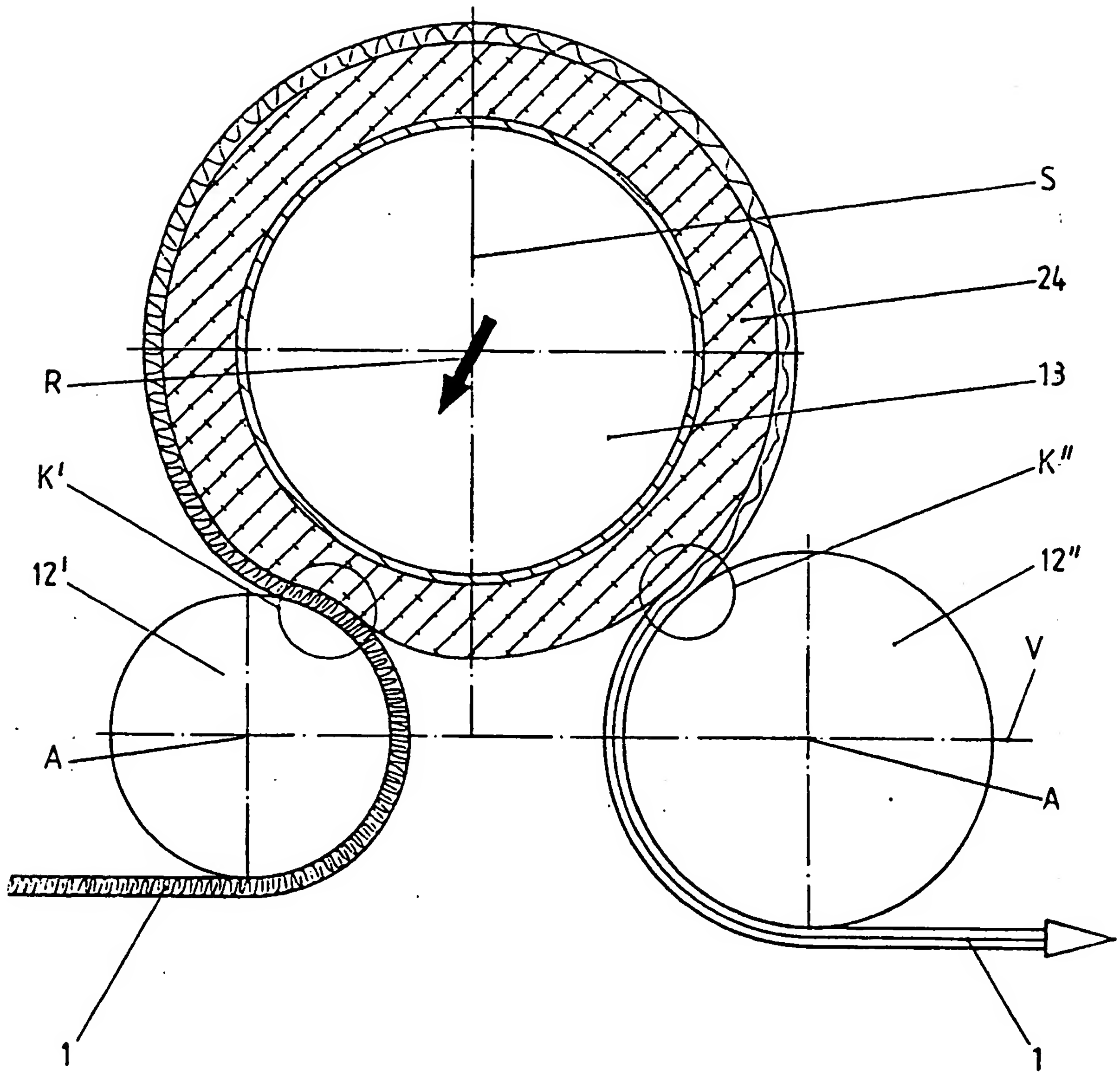


Fig.4



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